PCIM-DAS1602/16

Analog & Digital I/O Board

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About this User's Guide

What you will learn from this user's guide

This user's guide explains how to install, configure, and use the PCIM-DAS1602/16 device so that you get the most out of its analog, digital and counter I/O features.

This user's guide also refers you to related documents available on our web site, and to technical support resources that can also help you get the most out of this device.

Conventions in this user's guide

For more information on …

Text presented in a box signifies additional information and helpful hints related to the subject matter you are reading.

Caution! Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

<#:#>	Angle brackets that enclose numbers separated by a colon signify a range of numbers, such those assigned to registers, bit settings, etc.
bold text	**Bold text** is used for the names of objects on the screen, such as buttons, text boxes, and check boxes. For example: **1.** Insert the disk or CD and click the **OK** button.
italic text	*Italic text* is used for the names of manuals and help topic titles, and to emphasize a word or phrase. For example: ▪ The *Insta*Cal installation procedure is explained in the *Software Installation Manual*. ▪ *Never* touch the exposed pins or circuit connections on the board.

Where to find more information

The following electronic documents provide information that can help you get the most out of your PCIM-DAS1602/16.

- MCC's *Guide to Signal Connections* is available on our web site at www.mccdaq.com/signals/signals.pdf.
- MCC's *Register Map for the PCIM-DAS1602/16* is available on our web site at www.mccdaq.com/registermaps/RegMapPCIM-DAS1602-16.pdf.
- MCC's *Specifications: PCIM-DAS1602/16* (the PDF version of Chapter 5 in this guide) is available on our web site at www.mccdaq.com/pdfs/PCIM-DAS1602-16.pdf
- MCC's *Universal Library User's Guide* is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-user-guide.pdf.
- MCC's *Universal Library Function Reference* is available on our web site at www.mccdaq.com/PDFmanuals/sm-ul-functions.pdf

This user's manual is also available on our web site at www.mccdaq.com/PDFmanuals/PCIM-DAS1602-16.pdf.

Introducing the PCIM-DAS1602/16

An Overview of PCIM-DAS1602/16 features

This manual explains how to configure, install, and use your PCIM-DAS1602/16 board. The PCIM-DAS1602/16 is a multifunction measurement and control board designed to operate in computers with PCI bus accessory slots.

The PCIM-DAS1602/16 provides either eight differential or 16 single-ended input channels, 16-bit A/D resolution, 100 kHz sample rate, dual 12-bit analog outputs, 32 DIO channels and three 16-bit counters.

Software features–*Insta*Cal™ and Universal Library™

The PCIM-DAS1602/16 is shipped with the *Insta*Cal™ software utility package. *Insta*Cal is a complete installation, calibration, and diagnostic program for data acquisition and control boards. Complete with extensive error checking, *Insta*Cal guides you through installation and setup of your data acquisition board and creates the board configuration file for use by your program or application software package. The *Insta*Cal installation procedure is explained in MCC's *Software Installation Manual* (available at http://www.mccdaq.com/PDFmanuals/sm-installation.pdf).

The optional Universal Library™ fully supports the PCIM-DAS1602/16. The Universal Library is a complete set of I/O libraries and drivers for all MCC boards, and for all Windows-based languages. When using the Universal Library, you can switch boards or even programming languages and the syntax remains constant.

Installing the Board

What is included with your board

As you unpack your board, make sure each of the items shown below is included:

Standard components

The following items should be included with your shipment:

- PCIM-DAS1602/16

- *Insta*Cal installation CD.
- MCC's *Software Installation Manual*

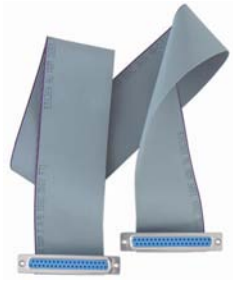
Optional components

If you ordered any of the following products with your PCIM-DAS1602/16 board, they should be included with your shipment.

Universal Library

- Universal Library™ Data Acquisition and Control Programming Tools (*Insta*Cal installation package is included on the CD)
- *Universal Library User's Guide* and *Universal Library Function Reference*.

Cables



C37FF-*x*

C37FFS-*x*

BP40-37

Screw terminal panels and signal conditioning products

MCC provides signal termination and signal conditioning products for use with the PCIM-DAS1602/16. Refer to the "Field wiring, signal termination and signal conditioning" section for a complete list of compatible accessory products.

If any items are missing or damaged, notify Measurement Computing Corp. immediately by phone, fax, or e-mail:

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@measurementcomputing.com

Unpacking the board

The PCIM-DAS1602/16 boards are shipped in an antistatic container to prevent damage by an electrostatic discharge. To avoid such damage, perform the following procedure when unpacking and handling your board.

1. Before opening the antistatic container, ground yourself with a wrist-grounding strap or by holding onto a grounded object (such as the computer chassis).
2. Touch the antistatic container to the computer chassis before removing the board from the container.
3. Remove the board from the container. *Never* touch the exposed pins or circuit connections on the board.

Installing the software

Install the *Insta*Cal software included with your board *before* you install the hardware. This ensures that the information required for proper board detection is installed and available at boot up. The procedure for installing *Insta*Cal is explained in the *Software Installation Manual* included with your board (and also available on our web site at www.mccdaq.com/PDFmanuals/sm-installation.pdf).

If you ordered the Universal Library…

If you ordered the optional Universal Library, use that CD to install both *Insta*Cal and the Universal Library.

Default hardware configuration

The PCIM-DAS1602/16 board has several switches and jumpers mounted on it that you must set before installing into your computer if you are not using the default settings. The factory-configured default settings are listed in Table 2-1. The locations of each switch and jumper are shown in Figure 2-1.

Table 2-1. Switch/Jumper Factory-Configured Defaults

Board Label	Switch/Jumper description	Default Setting
S1	Channel Select switch	8
S2	A/D Range Select switch	Bipolar
P2	Trigger Edge Select jumper	Rising Edge
P5, and P6	DAC0/DAC1 Bipolar/Unipolar Select jumpers	Bipolar
P7	DAC0 and DAC1 Range jumper	−5V to +5V
P8	Clock Select jumper - 1/10 MHz XTAL jumper	1 MHz

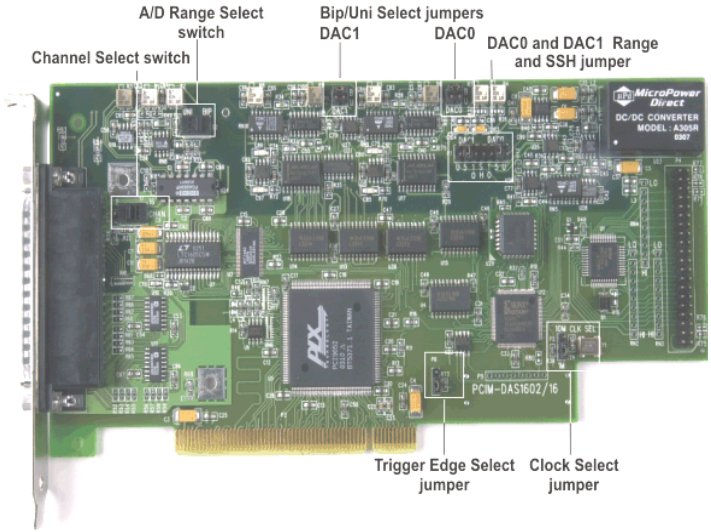


Figure 2-1. PCIM-DAS1602/16 switch and jumper locations

Before installing the PCIM-DAS1602/16 in the computer, verify that the board is configured with the settings that you want. Review the following information to change the default configuration of a jumper or switch on the PCIM-DAS1602/16 board.

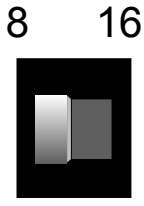
Board switches are covered by a metal nameplate

To access the Channel Select switch and the A/D Range Select switch, remove the metal nameplate that covers them. This plate is secured to the board with two screws.

Channel Select switch

Set the channel mode configuration with switch S1. The analog inputs of the PCIM-DAS1602/16 can be configured as eight differential channels or 16 single-ended channels. Use the single-ended input mode if you have more than eight analog inputs to sample. Using the differential input mode allows up to 10 volts of common mode (ground loop) rejection and will provide better noise immunity.

This switch is factory-configured for eight differential inputs. The Channel Select switch shown in Figure 2-2 is set to the "8" position. To configure for 16 channels, set this switch to 16.



8/16 CHANNEL SELECT SWITCH

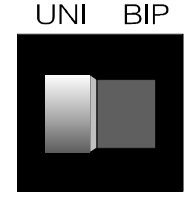
(8 Channels, Differential Input Mode Shown)

Figure 2-2. 8/16 Channel Select Switch

A/D Range Select switch

The A/D converter range is set by switch S2. This switch controls all A/D channels.

Although you cannot run some channels bipolar and some unipolar, you can measure a unipolar input in the bipolar mode (for example, you can monitor a 0 to 5V input with a channel set to the ±5 V range). This switch is factory-configured for bipolar. The A/D Range Select switch shown in Figure 2-3 is configured for unipolar.



BIP = Bipolar (+/-X) Ranges Selected
UNI = Unipolar (0-X) Ranges Selected

Figure 2-3. A/D Range Select Switch

Trigger Edge Select jumper

The original Keithley MetraByte DAS-1600 was designed such that A/D conversion initiates on the falling edge of the convert signal. Neither the original DAS-16, nor any of the other DAS-16 derivative converts on the falling edge of the signal. In fact, we are not aware of any A/D board that uses the falling edge to initiate the A/D conversion.

When using the falling edge to start the conversion, the A/D may be falsely triggered by 8254 pacer clock initialization glitching. False triggering is easy to avoid, but may occur in the DAS-1600. Since initiating conversions on the falling edge is undesirable, but initiating on the rising edge may lead to timing differences if the PCIM-DAS1602/16 board is used as a replacement for an older DAS16 series board, the PCIM-DAS1602/16 is equipped with a jumper that you can use to select the edge that initiates the A/D conversion.

The Trigger Edge Select mode is configured by jumper P8. This jumper is factory-configured for rising edge. Figure 2-4 shows the edge selection options.

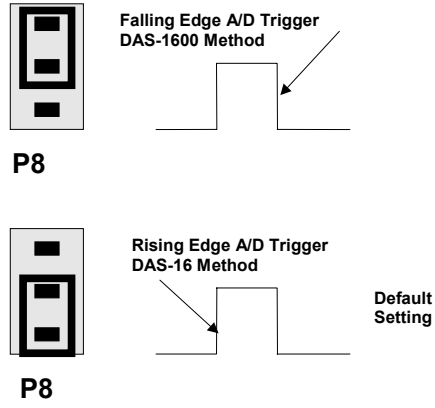


Figure 2-4. Trigger Edge Select Jumper

For compatibility with all third party packages, with all DAS-16 software, and with PCIM-DAS1602/16 software, leave this jumper in the default rising edge position.

DAC0 and DAC1 Range Select jumper (D/A Converter Reference)

The PCIM-DAS1602/16 has an on-board precision voltage reference at jumper P7 that you can use to select the output ranges of the digital to analog converters. Both of the board's D/A outputs are factory-configured with a range of −5 to +5 volts (Figure 2-5.)

Analog output is provided by two 12-bit multiplying D/A converters (DAC1 and DAC). This type of converter accepts an input reference voltage, and provides an output voltage which is both inverse to the reference voltage and proportional to the digital value in the output register. The proportion is controlled by the D/A output code (0 to 4095). Each bit represents 1/4096 of full scale. For example, in unipolar mode, the supplied reference of −5V provides a +5V output (actually 4.9988V) when the value in the output register is 4095 (full scale at 12 bits of resolution). It provides a value of 2.5V when the value in the output register is 2048.

A precision −5V and −10V reference provides onboard D/A ranges of 0 to 5V, 0 to 10V, ±5V, ±10V. Other ranges between 0V and 10V are available when you provide a precision voltage reference at pin 10 (D/A0) or pin 26 (D/A1) of the board's main connector.

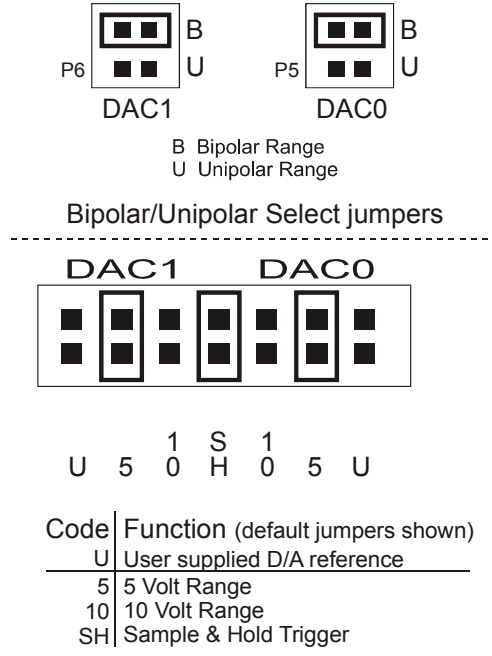


Figure 2-5. D/A0 and D/A1 Range jumper

Simultaneous sample and hold (SSH) trigger

When the DAC1 reference is supplied on-board, pin 26 of the 37-pin connector is unused (Figure 2-7). You can enable this pin as a SSH (simultaneous sample & hold) trigger for use with the CIO-SSH16 board. To configure this, place the jumper between the two pins labeled **SH**, as shown above in Figure 2-5.

Clock Select jumper

Jumper P2 configures the frequency of the square wave used as a clock by the A/D pacer circuitry. This pacer circuitry controls the sample timing of the A/D.

You can configure the frequency for 10 MHz or 1 MHz. The Clock Select jumper is factory-configured for 1 MHz, as shown in Figure 2-6.

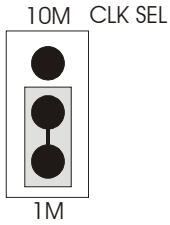


Figure 2-6. Clock Select jumper

Configure this jumper for 10 MHz, unless you have reason to do otherwise.

Internal pacer output is also available at pin 20

The internal pacer output driving the A/D converter is also available at pin 20 (CTR 3 Output) on the board's main I/O connector (see Figure 2-7).

Installing the hardware

After you configure the board's switches and jumpers, install the PCIM-DAS1602/16 into your computer. To install your board, follow the steps below.

Install *Insta*Cal before you install your board

Information files needed to detect your board are installed as part of the *Insta*Cal installation. Therefore, it is preferable to install *Insta*Cal before you install your board. Follow the directions for installing *Insta*Cal in the *Software Installation Manual* shipped with your board.

1. Turn your computer off, open it up, and insert your board into an available PCI slot.
2. Close your computer and turn it on.

   If you are using an operating system with support for plug-and-play (such as Windows 95 or Windows 2000), a dialog box displays as the system loads, indicating that new hardware has been detected. If the information file for this board is not already loaded onto your PC, you are prompted for the disk containing this file. The *Insta*Cal software supplied with your board contains this file. If required, insert the disk or CD and click **OK**.

3. Run the *Insta*Cal utility software that you installed in the previous section to test your installation and review the board's configuration. Refer to the *Software Installation Manual* that came with your board for information on how to initially set up and load *Insta*Cal (www.mccdaq.com/PDFmanuals/sm-installation.pdf).

Board configuration with *Insta*Cal

If you change the board configuration with *Insta*Cal, you may have to also physically change the setting of a corresponding switch or jumper on the board. Refer to Default hardware configuration on page 2-4 for specific jumper and switch information.

4. For optimum performance, allow your computer to warm up for at least 15 minutes before acquiring data with this board. The high speed components used on the board generate heat, and it takes this amount of time for a board to reach steady state if it has been powered off for a significant amount of time.

Connecting the board for I/O operations

Connectors, cables – main I/O connector

The PCIM-DAS1602/16 board has a 37-pin connector for analog connections and a 40-pin connector for digital I/O connections. Table 2-2 lists the board connectors, applicable cables, and compatible accessory products for the PCIM-DAS1602/16.

Table 2-2. Board Connectors, Cables, Accessory Equipment

Analog connector type	37 pin male “D” connector
Digital connector type	40-pin header connector
Compatible cables	C37FF-*x* (Figure 2-10) C37FFS-*x* (Figure 2-11) BP40-37 (Figure 2-12)
Compatible accessory products (with the *C37FF-x* cable or *C37FF*s-*x* cable)	CIO-MINI37 SCB-37 ISO-RACK16 ISO-DA02
Compatible accessory products (with the *C37FF- x* cable or *C37FF*s-*x* cable connected to the BP40-37 cable)	CIO-ERB08 CIO-ERB24 SSR-RACK08 SSR-RACK24

Analog Connector

The PCIM-DAS1602/16 board's analog connector is a 37-pin "D" connector that is accessible from the rear of the PC on the expansion back plate. This connector accepts female 37-pin D-type connectors, such as the C37FF-*x* 37-pin cable (Figure 2-10) or the C37FFS-*x* 37-pin shielded cable (Figure 2-11).

An additional signal, SS&H OUT (Simultaneous Sample and Hold Output), is available at pin 26 of the analog connector. This pin is required when the CIO-SSH16 board is used with a PCIM-DAS1602/16. Refer to Simultaneous sample and hold (SSH) trigger on page 2-7 for information on how to configure this pin.

Digital connector

The board's digital I/O connector is a 40-pin connector that is mounted at the rear of the PCIM-DAS1602/16. This connector accepts a 40-pin header connector (Figure 2-12).

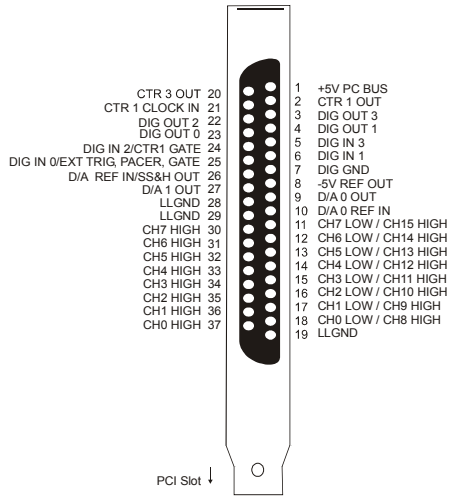
The optional BP40-37 cable assembly brings the signals to a back plate with a 37-pin male connector mounted in it. When connected through the BP40-37 cable, the PCIM-DAS1602/16 board's digital connector is identical to the CIO-DIO24 connector.

Analog and digital connections and configuration

General information on analog and digital signal connections and configuration is contained in the *Guide to Signal Connections* (available on our web site at http://www.mccdaq.com/signals/signals.pdf).

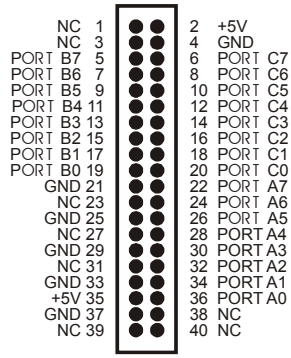
Pinout – Analog I/O connector

Figure 2-7. Main I/O connector


CTR 3 OUT 20
CTR 1 CLOCK IN 21
DIG OUT 2 22
DIG OUT 0 23
DIG IN 2/CTR1 GATE 24
DIG IN 0/EXT TRIG, PACER, GATE 25
D/A REF IN/SS&H OUT 26
D/A 1 OUT 27
LLGND 28
LLGND 29
CH7 HIGH 30
CH6 HIGH 31
CH5 HIGH 32
CH4 HIGH 33
CH3 HIGH 34
CH2 HIGH 35
CH1 HIGH 36
CH0 HIGH 37
1 +5V PC BUS
2 CTR 1 OUT
3 DIG OUT 3
4 DIG OUT 1
5 DIG IN 3
6 DIG IN 1
7 DIG GND
8 -5V REF OUT
9 D/A 0 OUT
10 D/A 0 REF IN
11 CH7 LOW / CH15 HIGH
12 CH6 LOW / CH14 HIGH
13 CH5 LOW / CH13 HIGH
14 CH4 LOW / CH12 HIGH
15 CH3 LOW / CH11 HIGH
16 CH2 LOW / CH10 HIGH
17 CH1 LOW / CH9 HIGH
18 CH0 LOW / CH8 HIGH
19 LLGND
PCI Slot

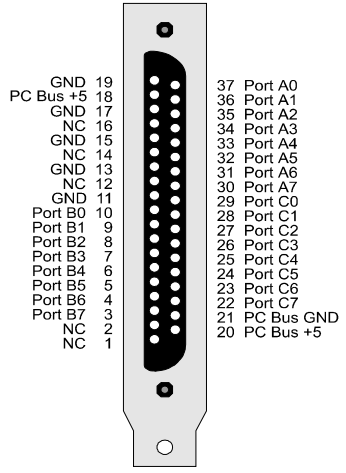
Pinout – Digital I/O connector

Figure 2-8. Digital I/O connector



Pinout – BP40-37 cable

Figure 2-9. BP40-37 pinout



Cabling

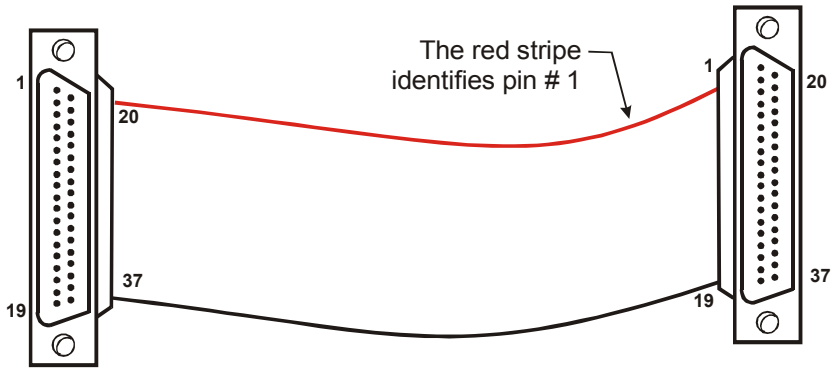


Figure 2-10. C37FF-*x* cable

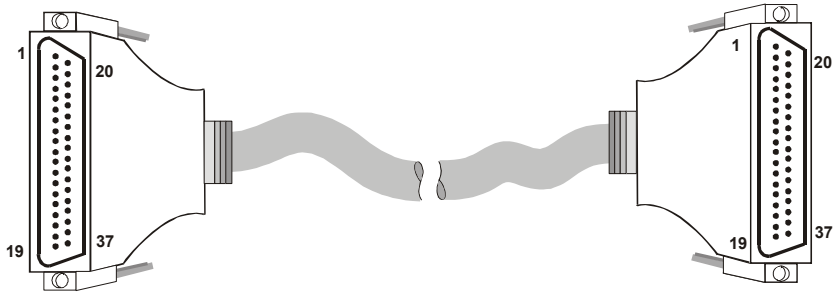


Figure 2-11. C37FFS-*x* cable

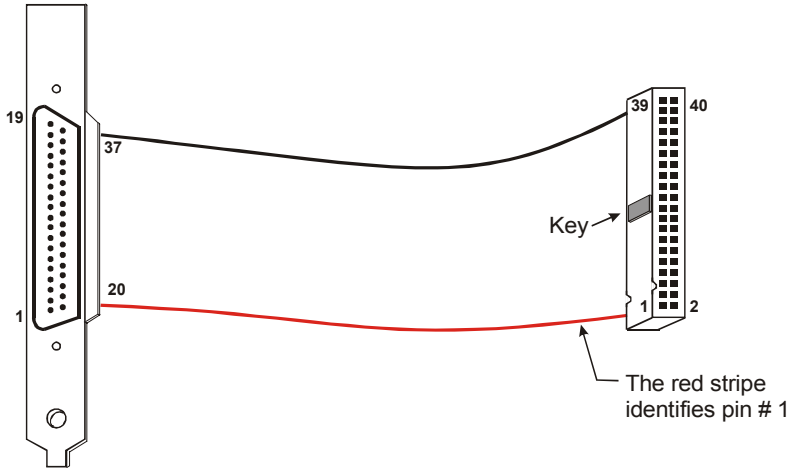


Figure 2-12. BP40-37 cable

Field wiring, signal termination and signal conditioning

You can use the following MCC screw terminal boards to terminate field signals and route them into the PCIM-DAS1602/16 board using the C37FF-*x* or C37FFS-*x* cable:

- **CIO-MINI37** – 37-pin screw terminal board. Details on this product are available at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=102&pf_id=255.
- **SCB-37** – 37 conductor, shielded signal connection/screw terminal box that provides two independent 50-pin connections. Details on this product are available at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=196&pf_id=1166.

MCC provides the following analog signal conditioning products for use with the PCIM-DAS1602/16 board:

- **ISO-RACK16** – Isolated 16-channel, 5B module rack for analog signal conditioning and expansion. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=127&pf_id=450.
- **ISO-DA02** – Isolated 2-channel, 5B module rack for analog signal conditioning and expansion. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=128&pf_id=703.

MCC provides the following digital signal conditioning products for use with the PCIM-DAS1602/16 board:

- **CIO-ERB08** – 8-channel, Form C relay accessory board for digital signal conditioning. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=123&pf_id=240.
- **CIO-ERB24** – 24-channel, Form C relay accessory board for digital signal conditioning. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=123&pf_id=241.
- **SSR-RACK08** – 8-channel, solid-state relay mounting rack for digital signal conditioning. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=122&pf_id=620.
- **SSR-RACK24** – 24-channel, solid-state relay mounting rack for digital signal conditioning. Details on this product are available on our web site at www.mccdaq.com/cbicatalog/cbiproduct.asp?dept_id=122&pf_id=1193.

Programming and Developing Applications

After following the installation instructions in Chapter 2, your board should now be installed and ready for use. There are three common approaches for generating operating software for the PCIM-DAS1602/16:

- Writing custom software with our Universal Library package
- Using a fully integrated software package such as SoftWIRE®
- Direct, register-level programming

Programming languages

Measurement Computing's Universal Library® provides access to board functions from a variety of Windows programming languages. If you are planning to write programs, or would like to run the example programs for Visual Basic® or any other language, refer to the *Universal Library User's Guide* (available on our web site at http://www.mccdaq.com/PDFmanuals/sm-ul-user-guide.pdf).

Packaged applications programs

Many packaged application programs, such as SoftWIRE®, Labtech Notebook™, and HP-VEE™, now have drivers for your board. If the package you own does not have drivers for the board, please fax or e-mail the package name and the revision number from the install disks. We will research the package for you and advise how to obtain drivers.

Some application drivers are included with the Universal Library package, but not with the application package. If you have purchased an application package directly from the software vendor, you may need to purchase our Universal Library and drivers. Please contact us by phone, fax or e-mail:

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@measurementcomputing.com

Register-level programming

You should use the Universal Library or one of the packaged application programs mentioned above to control your board. Only experienced programmers should try register-level programming. If you need to program at the register level in your application, refer to the *Register Map for the PCIM-DAS1602/16* (available at www.mccdaq.com/registermaps/RegMapPCIM-DAS1602-16.pdf).

Calibrating the Board

The PCIM-DAS1602/16 is shipped fully calibrated from the factory. For normal environments, you should calibrate your PCIM-DAS1602/16 board using *Insta*Cal's calibration procedures every six months–to-a year. If frequent variations in temperature or humidity are common, recalibrate at least every three months. It requires less than 20 minutes to calibrate the board using *Insta*Cal.

The *Insta*Cal calibration procedure is explained in the *Software Installation Manual* that was shipped with your board.

Calibrating the A/D & D/A converters

*Insta*Cal provides step-by-step on-screen instructions to guide you in calibrating your board. You calibrate the board's A/D converters by applying a known voltage to an analog input channel and adjusting trim pots for offset and gain. There are three trim pots that require adjustment to calibrate the analog input section of the board. There are also three pots associated with each of the analog output channels.

Calibrate the PCIM-DAS1602/16 for the range you intend to use it in. When the range is changed, slight variation in Zero and Full Scale may result. These variations can be measured and removed in software if necessary.

Required equipment

To calibrate the PCIM-DAS1602/16, you need a precision voltage source, or a non precision source and a 5½ digit digital voltmeter and a few pieces of wire. Use a jeweler’s screwdriver to adjust the trim pots. An extender card is not required to calibrate the board.

Specifications

Typical for 25°C unless otherwise specified

Power Consumption

+5V quiescent	820mA typical, 1.4A max

Analog Input Section

A/D converter type	LTC1605CSW
Resolution	16 bits
Number of channels	16 single-ended / 8 differential, switch selectable
Input ranges ▪ Gain is software selectable ▪ Unipolar/Bipolar polarity is switch selectable	±10V, ±5V, ±2.5V, ±1.25V 0 to 10V, 0 to 5V, 0 to 2.5V, 0 to 1.25V
A/D Pacing (software programmable)	Internal counter - 82C54. Positive or negative edge, jumper selectable.
	External source (pin25), Positive or negative edge, software selectable.
	Software polled
A/D Trigger (only available when internal pacing selected, software enable/disable)	External edge trigger (pin 25), Positive or negative edge, software selectable.
A/D Gate (only available when internal pacing selected, software enable/disable)	External gate (pin 25), High or Low level, software selectable.
Simultaneous Sample and Hold Trigger	TTL output (pin 26), jumper enabled. Logic 0 = Hold, Logic 1 = Sample Compatible with CIO-SSH16
Burst Mode	Software selectable option, burst interval = 10uS
Data Transfer	From 1024 sample FIFO via interrupt w/ REPINSW
	Interrupt
	Software polled
Interrupt	INTA# - mapped to IRQn via PCI BIOS at boot-time
Interrupt enable	Programmable through PLX9052
Interrupt polarity	Active high level or active low level, programmable through PLX9052

Interrupt Sources (software programmable)	End of Conversion
	FIFO not Empty
	End of Burst
	End of Acquisition
	FIFO Half Full
A/D conversion time	10µs max
Throughput	100KHz
Common Mode Range	±10V min
CMRR @ 60Hz	-100dB typ, -80dB min
Input leakage current	±3nA max
Input impedance	10 MOhms min
Absolute maximum input voltage	+55/-40V fault protected via input mux

Accuracy

Typical Accuracy	±2.3 LSB
Absolute Accuracy	±5.0 LSB
Accuracy Components:	
Gain Error	Trimmable by potentiometer to 0
Offset Error	Trimmable by potentiometer to 0
PGA Linearity Error	±1.3 LSB typ , ±10.0 LSB max
Integral Linearity Error	±0.5 LSB typ , ±3.0 LSB max
Differential Linearity Error	±0.5 LSB typ, ±2.0 LSB max

Each PCIM-DAS1602/16 is tested at the factory to assure the board's overall error does not exceed ±5 LSB.
Total board error is a combination of Gain, Offset, Differential Linearity and Integral Linearity error. The theoretical absolute accuracy of the board may be calculated by summing these component errors. Worst case error is realized only in the unlikely event that each of the component errors are at their maximum level, and causing error in the same direction.

Analog Input Drift

Range	Analog Input Full-Scale	Analog Input	Overall Analog Input
± 10.00V	2.2 LSB/°C max	1.8 LSB/°C max	4.0 LSB/°C max
± 5.000V	2.2 LSB/°C max	1.9 LSB/°C max	4.1 LSB/°C max
± 2.500V	2.2 LSB/°C max	2.0 LSB/°C max	4.2 LSB/°C max
± 1.250V	2.2 LSB/°C max	2.3 LSB/°C max	4.5 LSB/°C max
0 - 10.00V	4.1 LSB/°C max	1.9 LSB/°C max	6.0 LSB/°C max
0 - 5.000V	4.1 LSB/°C max	2.1 LSB/°C max	6.2 LSB/°C max
0 - 2.500V	4.1 LSB/°C max	2.4 LSB/°C max	6.5 LSB/°C max
0 - 1.250V	4.1 LSB/°C max	3.0 LSB/°C max	7.1 LSB/°C max

Absolute error change per °C Temperature change is a combination of the Gain and Offset drift of many components. The theoretical worst case error of the board may be calculated by summing these component errors. Worst case error is realized only in the unlikely event that each of the component errors are at their maximum level, and causing error in the same direction.

Noise Performance

The following table summarizes the worst case noise performance for the PCIM-DAS1602/16. Noise distribution is determined by gathering 50000 samples with inputs tied to ground at the PCIM-DAS1602/16 main connector. Data is for both Single-Ended and Differential modes of operation.

Range	±2 counts	±1 count	Max Counts	LSBrms*
± 10.00V	97%	80%	11	1.7
± 5.000V	97%	80%	11	1.7
± 2.500V	96%	79%	11	1.7
± 1.250V	96%	79%	11	1.7
0 - 10.00V	88%	65%	15	2.3
0 - 5.000V	88%	65%	15	2.3
0 - 2.500V	83%	61%	15	2.3
0 - 1.250V	83%	61%	16	2.4

* Input noise is assumed to be Gaussian. An RMS noise value from a Gaussian distribution is calculated by dividing the peak-to-peak bin spread by 6.6

Crosstalk

Crosstalk is defined here as the influence of one channel upon another when scanning two channels at the specified per channel rate for a total of 50000 samples. A full scale 100Hz triangle wave is input on Channel 1. Channel 0 is tied to Analog Ground at the 100 pin user connector. The table below summarizes the influence of Channel 1 on Channel 0, and does not include the effects of noise.

Range	1 kHz Crosstalk (LSB $_{pk-pk}$)	10 kHz Crosstalk (LSB $_{pk-pk}$)	50 kHz Crosstalk (LSB $_{pk-pk}$)
± 10.000V	4	13	24
± 5.000V	2	7	18
± 2.500V	2	5	16
± 1.250V	3	4	14
0V to +10.000V	4	8	23
0V to +5.000V	2	5	16
0V to +2.500V	2	4	16
0V to +1.250V	3	3	16

Analog Output Section

D/A converter type	MX7548
Resolution	12 bits
Number of channels	2
Channel Type	Single-ended Voltage Output
Output Range (jumper selectable per output)	±10V, ±5V, 0 to 10V, or 0 to 5V using onboard references, or user defined using external reference
Reference Voltage (jumper selectable)	On Board, -10V and –5V
	External Independent (D/A0 pin 10 and D/A1 pin 26)
External Reference Voltage Range	±10V max
External Reference Input Impedance	10KOhm min
Data transfer	Programmed I/O
Throughput	System dependent. Using the Universal Library programmed output function (`cbAout`) in a loop, in Visual Basic, a typical update rate of 400Khz can be expected on a 300MHz Pentium II based PC.
Monotonicity	Guaranteed monotonic over temperature
Slew Rate	2.0V/µs min
Settling Time	30µS max to ±½ LSB for a 20V step
Current Drive	±5 mA min
Output short-circuit duration	Indefinite @25mA
Output coupling	DC
Output impedance	0.1 ohms max
Output Stability	Any passive load
Coding	Offset Binary ▪ Bipolar Mode: 0 code = Vref 4095 code = -Vref – 1LSB, Vref < 0V -Vref + 1LSB, Vref >0V ▪ Unipolar Mode: 0 code = 0V 4095 code = -Vref – 1LSB, Vref < 0V -Vref + 1LSB, Vref >0V
Output voltage on power up and reset	0V ± 10mV

Accuracy

Typical Accuracy	±1 LSB
Absolute Accuracy	±2 LSB
Accuracy Components	
Gain Error	Trimmable by potentiometer to 0
Offset Error	Trimmable by potentiometer to 0
Integral Linearity Error	±0.5 LSB typ, ±1 LSB max
Differential Linearity Error	±0.5 LSB typ, ±1 LSB max

Total board error is a combination of Gain, Offset, Differential Linearity and Integral Linearity error. The theoretical absolute accuracy of the board may be calculated by summing these component errors. Worst case error is realized only in the unlikely event that each of the component errors are at their maximum level, and causing error in the same direction.

Analog Output Drift

Analog Output Full-Scale Gain drift	±0.22 LSB/°C max
Analog Output Zero drift	±0.22 LSB/°C max
Overall Analog Output drift	±0.44 LSB/°C max

Absolute error change per °C Temperature change is a combination of the Gain and Offset drift of many components. The theoretical worst case error of the board may be calculated by summing these component errors. Worst case error is realized only in the unlikely event that each of the component errors are at their maximum level, and causing error in the same direction.

Digital Input / Output Section

Digital I/O Connector

Digital Type	82C55
Number of I/O	24
Configuration per 82C55	▪ 2 banks of 8 and 2 banks of 4 or ▪ 3 banks of 8 or ▪ 2 banks of 8 with handshake
Input High	2.0 volts min, 5.5 volts absolute max
Input Low	0.8 volts max, –0.5 volts absolute min
Output High	3.0 volts min @ –2.5mA
Output Low	0.4 volts max @ 2.5mA
Power-up / reset state	Input mode (high impedance)
Pull-Up/Pull-Down Resistors	User installed. Dual footprint allows pull-up or pull-down configuration

Main Connector

Digital Output Type	74LS244, power up / reset to LOW logic level
Digital Input Type	74LS373, pulled to logic high via 10K resistors
Number of I/O	8
Configuration	4 fixed input, 4 fixed output
Output High	2.7 volts @ –0.4mA min
Output Low	0.5 volts @ 8mA max
Input High	2.0 volts min, 7 volts absolute max
Input Low	0.8 volts max, –0.5 volts absolute min

Counter Section

*Note: Pins 21, 24, and 25 are pulled to logic high via 10K resistors.

Counter type	82C54
Configuration	3 down-counters, 16 bits each
Counter 1 Source (software selectable)	External source from main connector (pin 21*)
	100 kHz internal source
Counter 1 Gate	External gate from main connector (pin 24*)
Counter 1 Output	Available at main connector (pin 2)
Counter 2 Source (jumper selectable)	Internal 1 MHz
	Internal 10 MHz
Counter 2 Gate (software enable/disable)	External source from main connector (pin 25*)
Counter 2 Output	Internal only, chained to Counter 3 Source
Counter 3 Source	Counter 2 Output
Counter 3 Gate (software enable/disable)	External source from main connector (pin 25*)
Counter 3 Output	Available at main connector (pin 20) Programmable as ADC Pacer clock.
Clock input frequency	10 MHz max
High pulse width (clock input)	30 ns min
Low pulse width (clock input)	50 ns min
Gate width high	50 ns min
Gate width low	50 ns min
Input High	2.0 volts min, 5.5 volts absolute max
Input Low	0.8 volts max, –0.5 volts absolute min
Output High	3.0 volts min @ –2.5 mA
Output Low	0.4 volts max @ 2.5 mA
Crystal Oscillator Frequency	10 MHz
Frequency accuracy	50 ppm

Environmental

Operating Temperature Range	0 to 70°C
Storage Temperature Range	–40 to 100°C
Humidity	0 to 95% non-condensing

Mechanical

Card dimensions	PCI custom type card: 107mm H x 18.5mm W x 216 mm L

Main Connector and Pin Out

Connector type	37 pin male “D” connector
Connector Compatibility	Identical to CIO-DAS1602/16 Connector

Differential Analog Input Mode

Pin	Signal Name	Pin	Signal Name
1	+5V PC BUS POWER	20	CTR 3 OUT
2	CTR 1 OUT	21	CTR 1 CLOCK IN
3	DIG OUT 3	22	DIG OUT 2
4	DIG OUT 1	23	DIG OUT 0
5	DIG IN 3	24	DIG IN 2 / CTR1 GATE
6	DIG IN 1	25	DIG IN 0 / EXT TRIG / EXT PACER / EXT GATE
7	DIG GND	26	D/A1 REF IN / SS&H OUT
8	–5V REF OUT	27	D/A 1 OUT
9	D/A 0 OUT	28	AGND
10	D/A0 REF IN	29	AGND
11	CH7 LO	30	CH7 HIGH
12	CH6 LO	31	CH6 HIGH
13	CH5 LO	32	CH5 HIGH
14	CH4 LO	33	CH4 HIGH
15	CH3 LO	34	CH3 HIGH
16	CH2 LO	35	CH2 HIGH
17	CH1 LO	36	CH1 HIGH
18	CH0 LO	37	CH0 HIGH
19	AGND		

Single-Ended Analog Input Mode

Pin	Signal Name	Pin	Signal Name
1	+5V PC BUS POWER	20	CTR 3 OUT
2	CTR 1 OUT	21	CTR 1 CLOCK IN
3	DIG OUT 3	22	DIG OUT 2
4	DIG OUT 1	23	DIG OUT 0
5	DIG IN 3	24	DIG IN 2 / CTR1 GATE
6	DIG IN 1	25	DIG IN 0 / EXT TRIG / EXT PACER / EXT GATE
7	DIG GND	26	D/A1 REF IN / SS&H OUT
8	–5V REF OUT	27	D/A 1 OUT
9	D/A 0 OUT	28	AGND
10	D/A0 REF IN	29	AGND
11	CH15 HIGH	30	CH7 HIGH
12	CH14 HIGH	31	CH6 HIGH
13	CH13 HIGH	32	CH5 HIGH
14	CH12 HIGH	33	CH4 HIGH
15	CH11 HIGH	34	CH3 HIGH
16	CH10 HIGH	35	CH2 HIGH
17	CH9 HIGH	36	CH1 HIGH
18	CH8 HIGH	37	CHO HIGH
19	AGND		

Digital Input / Output Connector and Pin Out

Connector Type	40-pin header
Connector Compatibility	Identical to CIO-DAS1602/16 Connector

Pin	Signal Name	Pin	Signal Name
1	NC	2	+5V PC BUS POWER
3	NC	4	DIG GND
5	PORT B 7	6	PORT C 7
7	PORT B 6	8	PORT C 6
9	PORT B 5	10	PORT C 5
11	PORT B 4	12	PORT C 4
13	PORT B 3	14	PORT C 3
15	PORT B 2	16	PORT C 2
17	PORT B 1	18	PORT C 1
19	PORT B 0	20	PORT C 0
21	DIG GND	22	PORT A 7
23	NC	24	PORT A 6
25	DIG GND	26	PORT A 5
27	NC	28	PORT A 4
29	DIG GND	30	PORT A 3
31	NC	32	PORT A 2
33	DIG GND	34	PORT A 1
35	+5V PC BUS POWER	36	PORT A 0
37	DIG GND	38	NC
39	NC	40	NC

EC Declaration of Conformity

We, Measurement Computing Corporation, declare under sole responsibility that the product

PCIM-DAS1602/16	Analog and digital I/O board for the PCI Bus
Part Number	*Description*

to which this declaration relates, meets the essential requirements, is in conformity with, and CE marking has been applied according to the relevant EC Directives listed below using the relevant section of the following EC standards and other informative documents:

- EU EMC Directive 89/336/EEC: Essential requirements relating to electromagnetic compatibility.
- EN 55022 Class B (1995): Radiated and conducted emission requirements for information technology equipment.
- ENV 50204 (1995): Radio-frequency electromagnetic field immunity.
- EN 55024 (1998): EC generic immunity requirements.
- EN 50082-1 (1997): EC generic immunity requirements.
- EN 61000-4-2 (1995): Electrostatic discharge immunity.
- EN 61000-4-3 (1997) ENV 50204 (1996): RF immunity.
- EN 61000-4-4 (1995): Electric fast transient burst immunity.
- EN 61000-4-5 (1995): Surge immunity.
- EN 61000-4-6 (1996): Radio frequency common mode immunity.
- EN 61000-4-8 (1994): Power frequency magnetic field immunity.
- EN 61000-4-11 (1994): Voltage dip and interrupt immunity.

Carl Haapaoja, Vice-President of Design Verification

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